

## Article

# Educating Future Agricultural Engineers at the University of Burgos, Spain, through a Service-Learning Project on Rural Depopulation and Its Social Consequences

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**Abstract:** A Service-Learning Project (S-LP) is a teaching experience through which the concepts covered during an educational course can practically be applied to address a given social problem. It is therefore a useful teaching methodology to bring courses closer to the real world. An S-LP experience is reported in this paper that was conducted with students of agricultural engineering to address the problem of rural depopulation, through the design of agri-food buildings for industries, and economic activities that help to maintain a stable population. After the S-LP, a survey was administered to both students and teachers, to assess the success of this teaching experience. The responses of the students showed not only an awareness of the social problem that was addressed, but also a critical spirit that led them to seek the best possible answer, and a global vision of the issue. It helped them to reflect on all of its facets to arrive at a way of engaging with the social problem. Importantly, the students were able to reflect upon how engineers can also serve society through their technical knowledge. The teachers indicated that the S-LP motivated the students on the course, while enabling them to successfully learn the concepts, and to develop independent study skills searching for information. In general, an S-LP is an experience that the teachers in this study would recommend and that could be especially relevant for universities assuming a role as a social entity to heighten the visibility of social problems and needs.

**Keywords:** agricultural engineering; agri-food building; depopulation; qualitative analysis; reflection activity; rural environment; service-learning project; social service; university teaching; word-cloud mixed analysis



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## 1. Introduction

In the past, traditional university teaching was lecture-based. In the lecture hall, the teacher would explain the theoretical and/or practical concepts of the course to the students, who were passive listeners and note takers [1]. Student participation was limited to asking any doubts, if they considered it necessary, during the class [2]. However, in recent years, new methodologies have emerged with the purpose of involving students in their learning and showing the direct application of the aspects covered in class [3,4]. Outstanding examples of new teaching methodologies that seek to foster an active learning attitude among students include the flipped classroom, in which students must make a first approach to the concepts before the class in which they will be addressed [3,5]; collaborative learning, where students are encouraged to explain the concepts to each other [4]; and formative peer evaluation, where students correct the assignments of their classmates, give them feedback, and conduct an evaluation that is not counted for a grade [6]. The direct application of the aspects dealt with in class is achieved through

techniques such as virtual or on-site visits [7], and educational strategies such as a Service-Learning Project (S-LP).

An S-LP consists of a project or assignment related to the content of the course through which a direct service is provided to society [8]. In other words, it is a teaching activity through which the concepts studied in class are applied and, at the same time, offers a way of engaging with a social need [9]. The first experiences with S-LP date back to the last quarter of the 20th century [10,11], and they have been evolving ever since then [12,13]. Studies have shown that, through S-LP, students not only learn the concepts of the course, but they also learn how to apply them, demonstrating the social utility of one profession or another [14]. Furthermore, through S-LP experiences, students can develop skills such as effective communication, critical analysis, and professional ethics [15]. However, S-LP experiences also mean that society can learn, i.e., people whose needs are addressed can learn how certain issues can be tackled. It is therefore not only a question of student learning, but it is also a way for society to find paths through which they could engage with existing social problems [16]. Finally, it is a methodology that brings together the academic and social fields, promoting beneficial collaboration [17].

A teaching methodology based on S-LP experiences is valid for any field. Law and medicine are typical examples for this type of teaching experience [18,19], due to the widespread perception in society that these professions offer a direct service to society [19]. The performance of S-LP approaches within engineering is scarcer [17], perhaps because there is no widespread perception in society of the social service of engineering, although the social work of engineers is very broad [20,21]. For example, a civil engineer designs infrastructures for transportation and water supply, among others. A building engineer develops buildings to provide housing. And an agricultural engineer designs crops to provide food and infrastructures that develop the rural environment and improve rural living conditions. This perception is also not helped by the high number of concepts that have to be explained on technical university courses [22], generally of a very varied nature that are hardly conducive to focusing this type of activity on a specific social issue [23,24].

As indicated in other studies, only 8.5% of the studies published on S-LP in indexed journals are related to engineering [25]. If we look for studies that include the terms “service-learning” and “agricultural engineer” or “agricultural engineering”, they are almost non-existent. Within this field, the S-LP experiences developed by The Ohio State University stand out [26–28], which have allowed, among other aspects, the improvement of energy and water supply in agricultural plantations in Honduras [28]. Some S-LP experiences have also been developed in the field of thermodynamic agricultural engineering, in which it was concluded that this teaching methodology has improved the motivation and retention of concepts among students [29]. However, the number of S-LP experiences related to agricultural engineering is very low and, as indicated above, agricultural engineering is of immense social utility, so further projects could reinforce this teaching methodology [30].

In this paper, an S-LP experience is reported that formed part of the Bachelor’s Degree in Agroalimentary Engineering & the Rural Environment, at the University of Burgos, Spain. The objective of the project was, through the development of agri-food buildings, to try to mitigate the depopulation of rural areas and their low populations within the interior of Spain [31], among which is the province of Burgos that was also the geographical area of the S-LP. In this study, the S-LP and the projects that the students developed are described, after which the opinions of both the students and the teachers who implemented the project are analyzed in depth. The aim is to show that this type of teaching experience is useful for learning in the field of agricultural engineering, as well as enriching students at a personal level, allowing them to become aware of the social problems that can be addressed through their technical training and how they can contribute to that aim.

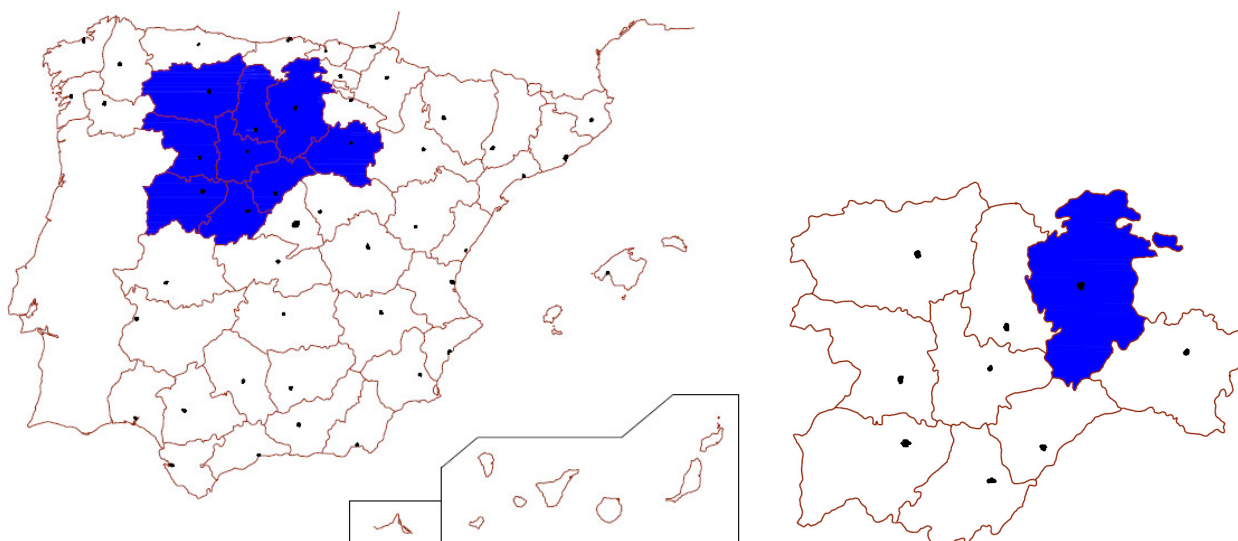
## 2. Description of the Service-Learning Project

### 2.1. Social Problem Addressed: Rural Depopulation

According to the latest available data from the Spanish Ministry of Agriculture, Fisheries and Food [32], the population living in rural areas of Spain, considering municipalities with fewer than 30,000 inhabitants and areas with population densities below 100 inhabitants per km<sup>2</sup>, is 7,538,929 inhabitants, which represents only 15.9% of the total population of Spain. This percentage is very low, as the rural environment in Spain represents 84.2% of the land mass. Moreover, the population is ageing fast. In the urban environment, 14.8% of the population is under 15 years old, while only 12.3% of the rural population is under 15 years old. On the other hand, 23.9% of the rural population is over 65 years old, while that percentage in the cities is 18.6%.

These figures are worrying, but they are even more so if their evolution over time is analyzed, and it is a fact that the population living in rural areas in Spain has been progressively decreasing over the years. For example, the population in rural areas has decreased by 7.1% over the decade from 2011 to 2020, despite the fact that population growth stands at 0.6% in Spain [32]. Besides, it leads to an increase in the average age of the population within the rural environment, with a clear tendency for young people to migrate to the cities [31]. It is widely recognized that not preventing the movement of young population away from rural environments is problematic, as it affects different professions such as agriculture, livestock, and various industries that are fundamental in the economic and social functioning of the country, and to successfully achieve so-called “sustainable development” [33]. Such is the scale of the problem that an organization called “España Vacía” [Emptied Spain] has even been launched to work towards the recovery of these rural areas [34].

It is also evident that not all areas of Spain present this problem. Coastal areas and large cities are more densely populated, and the problem of depopulation is found mainly in the interior of Spain [33]. Castilla y León, for example, is a region located in the north of Spain, where the rural population has decreased by 14.3% between 2000 and 2020 [32]. The province of Burgos, the spatial framework for the study of the S-LP, is located within that region, as shown in Figure 1.



**Figure 1.** Location of Castilla y León (left) and the province of Burgos (right) within Spain.

In view of the above, the S-LP under study was intended to address the problem of depopulation in rural areas of the province of Burgos, Spain, adopting the activation of the economy as a point of action. Thus, the aim was for future agricultural engineers to address the creation of farms and agri-food processing industries, through the design of agri-food buildings in places with potential for exploitation and commercialization. This

activity would help to sustainably fix the population within the rural environment, creating new workplaces [34].

It is important to note that the approach of the S-LP was only hypothetical, looking for students to find social utility in the design of agri-food buildings that would motivate their learning and involvement in the course, and their sense of social service. This hypothetical approach of an S-LP has been used in different studies regarding this type of teaching activity in the engineering field, including agricultural engineering, due to the economic resources necessary for the implementation of the solutions proposed through the S-LP [25,29]. Therefore, economic investment for the construction of the agri-food buildings was clearly beyond the teaching approach reported in this study.

## 2.2. Participants and Courses

The S-LP addressed in this study formed part of the Construction & Agroalimentary Building course in the third year, second semester, of the Bachelor's Degree in Agroalimentary Engineering & the Rural Environment at the University of Burgos, Spain. A total of 10 students participated in this S-LP, with an average age of  $21 \pm 1$  years. The reduced group of participating students allowed them to be actively involved in all the activities of the project. The S-LP was developed by the two teachers in charge of teaching the part of the course on agri-food building design, whose average age was  $35 \pm 11$  years old.

## 2.3. Service-Learning Project Approach

An approach of problem-based learning was adopted in the design of the teaching activity [35], as can be noted in the stages and reflection activities shown in this section. However, this teaching activity would also have service outcomes, also listed below, thus approaching it as an S-LP [25]. This classification as an S-LP was possible by understanding this type of teaching activity in a broad approach, since “*service-learning can also be defined as a form of education that matches a tangible need in a community with students participating in a learning experience*” [9].

### 2.3.1. Stages of the Project and Activities Conducted

The S-LP consisted of the following stages, labelled with the letter *S*, in order to address both the design of the agri-food buildings and the issue of rural depopulation:

- *S1*. Classroom presentation by the teachers of the important problem of rural depopulation, its possible causes, and its relevance for the sustainable development.
- *S2*. Sharing the main rural-development associations and identification of the most interesting areas for developing the actions with the students.
- *S3*. Classroom presentation of various proposals for the design of farms and agri-food buildings by the teachers.
- *S4*. Classroom debate involving students and teachers on the ideas collected during the previous stages, brainstorming, and exploring possible ways forward.
- *S5*. Development of agri-food building projects to address the social problem of rural depopulation (definition of the location, building type, and building design). Monitoring of the projects that the students developed by the teachers both in the classroom and in out-of-class tutorials.
- *S6*. Presentation, defense, and discussion of the proposals that were adopted and the designs that were developed.
- *S7*. Evaluation of the S-LP through a survey of open-ended questions whose questions and answers are presented in the following sections.

### 2.3.2. Reflection Activities

A series of activities for reflection, labelled *R*, were conducted during the S-LP. These activities consisted of a search for information followed by a debate in the classroom among the students themselves on the information found and the aspects related to the activity that the students were already familiar with. These debates, which were guided and moderated

by the teachers, aimed at getting the students to reflect together on the different aspects linked to the problem of rural depopulation, so that they would autonomously understand it as a whole in order to provide adequate solutions to it. These activities are detailed below:

- R1. Reflection on the rural areas with which the students were familiar (their village, or places they have visited for various reasons). Description of the existing population (number, age, professions, etc.). Identification of the main sources of income of the people living in these rural areas (agriculture, livestock, industry, tourism, etc.).
- R2. Definition of the type of environments (culture, art, nature, leisure, work, etc.) the general population is seeking and how to implement them in rural areas.
- R3. Identification of possible improvements to existing economic activities within rural areas.
- R4. List of potential businesses that could promote depopulated areas.
- R5. Discussion of possible sources of financing or fiscal measures, so as to implement the agri-food buildings that the students were designing.

The reflection activities were implemented at specific stages of the S-LP, as shown in Figure 2. The relationship between the stages of the S-LP and the reflection activities was bi-directional. Thus, the thematic of each stage was linked to the reflection activities that were conducted during it. In the same way, the reflection activities fostered learning and understanding of the social problem of rural depopulation in the students, which could be applied in the stage in which each reflection activity was performed and in subsequent ones.

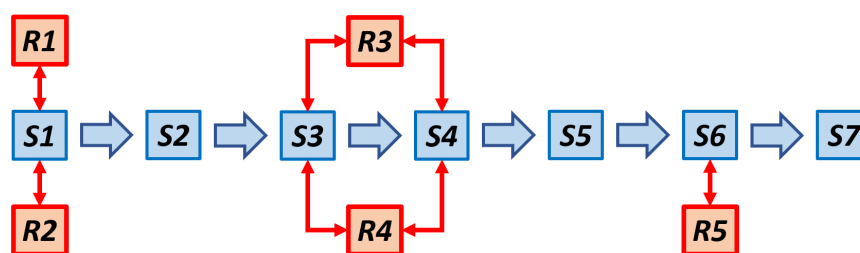


Figure 2. Links between the stages and the reflective activities of the S-LP.

Apart from these activities, the students were encouraged to visit the areas they had selected to implement their projects and to contact the local authorities and any rural-development associations to learn about the state of the area, its depopulation level, its needs, and the actions related to the agri-food buildings that might potentially be most successful in addressing the depopulation problem.

The reduced number of students participating in the S-LP allowed all of them to participate in all the reflection activities actively and effectively. This could clearly lead to a better understanding of the problem of rural depopulation and to a greater awareness of it. This is an aspect that should be considered in the evaluation of the results obtained from this study and in their extrapolation to an S-LP performed with a larger number of students.

### 2.3.3. Service Outcomes

In the S-LP approach, the following aspects were defined as service outcomes, i.e., as targets to be achieved in relation to the problem of rural depopulation:

- Raising the visibility of depopulation within rural areas of the province of Burgos and the identification of areas for action.
- Awareness of the students with regard to the rural-depopulation problem, on which they can take an active position, as future agricultural engineers.
- Proposal of different measures for the creation and modernization of farms and agri-food industries in the identified areas of action that can improve the rural economy and thus the stability of the rural population.

#### 2.3.4. Student Competencies

It was finally established that the S-LP should provide student learning based on the development of the teaching competencies listed below. Learning was divided into three different dimensions: academic, personal, and social.

##### Academic competencies:

1. Learning the necessary procedures for the design and the dimensioning of the areas within an agri-food building.
2. Learning how to design the structural components of an agri-food building.
3. Understanding the applicability of the design concepts covered in the course in professional practice.
4. Design of a calculation report and plans for the design of an agri-food building.
5. Public presentation and defense of the need for an action or a design.

##### Personal competencies:

6. Knowledge and contact with social entities and public administrations related to the project to be undertaken, obtaining the necessary information from them.
7. Identification of the information sources that form the basis of the need or problem to be addressed.
8. Development of autonomy in the search for information and ways to engage with a specific problem.

##### Social competencies:

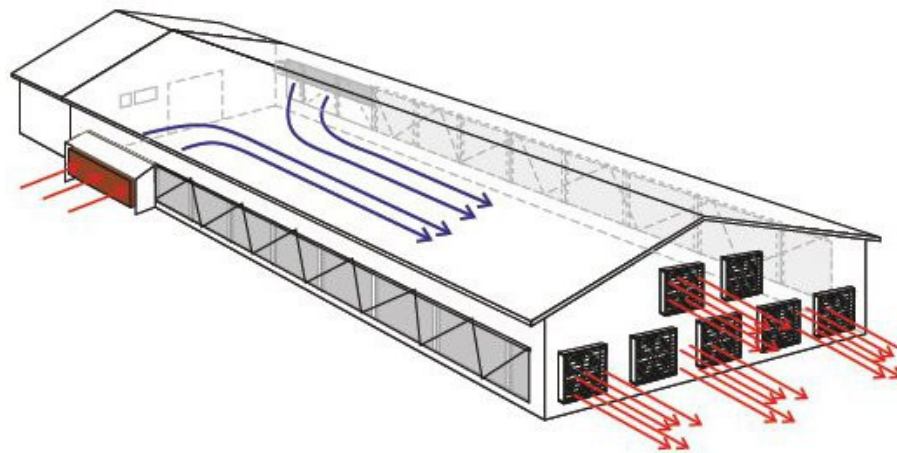
9. Internalization of the problem of rural depopulation and possible ways to address it, closely linked to the professional work of the agricultural engineer.
10. Understanding how the professional skills of an agricultural engineer can be applied to promote activities that can reduce depopulation based on their technical knowledge.
11. Learning how to identify social problems and to see the interface with their technical knowledge.

#### 2.4. Final Student Delivery

In this section, some of the projects of the students are briefly explained. The objective is to show how the students conceptualized the problem of rural depopulation and approached it through the development of agri-food buildings, based on all the information they were given during the stages and the activities of the S-LP. Since the projects were individually designed, only the most outstanding ones are presented below. Among the proposals were machinery storage buildings, grain storage facilities, feed storage facilities, poultry farms, swine farms, and composting plants. The students defined the location for their specific approach, after an independent search for information, and an analysis of the selected area and its features.

##### 2.4.1. Project 1

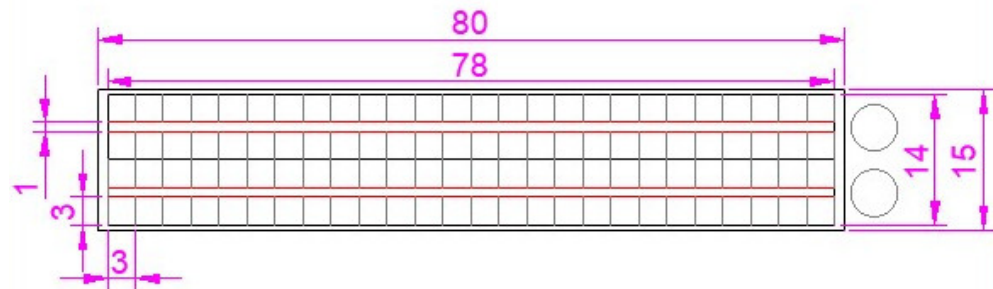
The first example of a project conducted by the students was a poultry farm located in the town of Monasterio de Rodilla, a municipality to the northeast of the city of Burgos, with a population of only 224 inhabitants. In view of the needs of the area, a building with a floor area of 2000 m<sup>2</sup>, a length of 100 m, and a width of 20 m was proposed. It would require an investment of EUR 330,000 with a 20-year investment payback period and could provide an estimated income per poultry fowl consignment of EUR 13,000. This building is illustrated in Figure 3 in which both the floor area and the ventilation are key aspects.



**Figure 3.** General view of the poultry farm [36].

#### 2.4.2. Project 2

The second example was a swine farm to be located in Castrillo Solarana, a municipality of approximately 178 inhabitants located to the south of the city of Burgos. A complex consisting of three annexed warehouses, each with a capacity for 1000 animals, was proposed. These buildings were designed with a length of 80 m, a width of 15 m, 104 pens of  $3 \times 3$  m, and two interior 1-m wide corridors, as detailed in Figure 4. The initial investment was estimated at EUR 300,000 with a 15-year payback period.



**Figure 4.** Swine housing dimensions.

### 3. Materials and Methods: Surveys to Assess the Service-Learning Project

#### 3.1. Surveys Conducted

After the completion of the S-LP, surveys were administered to both students and teachers to inquire into their opinions of the project. Open-ended questions were chosen so that both students and teachers could reflect on whatever they considered relevant. The questions were prepared on the basis of the research experience of the authors of the study [4,22] and on other similar studies [37,38].

The student survey consisted of two open-ended questions, which are shown below. The main objective of these questions was to ascertain the degree of understanding and awareness they had reached on the problem of rural depopulation, questioning them with regard to the utility of their designs and any other alternatives they might have proposed. Basically, the idea was to determine whether the service outcomes had been reached and whether the students had developed the social competencies set out in the S-LP.

1. Do you think that the agri-food buildings proposed by you and your classmates would really help to solve the problem of rural depopulation? What do you consider to be the main disadvantages for their success?
2. What other approaches from the agricultural-engineering approach can you think of to stop rural depopulation? Explain in detail what it would consist of and how it would address depopulation within the rural environment.

The teachers were given a survey consisting of six open-ended questions. The first four questions were formulated to discover their opinions of student learning, fundamentally determining whether they had acquired the academic and personal competencies established in the S-LP. The other two questions sought to ascertain the personal opinions of the teachers on the S-LP and their own learning during that time, with the aim of verifying the level of social awareness on rural depopulation that the S-LP generated, not only for the students, but also for the other actors, which is one of the central positive aspects of an S-LP teaching experience [23,24].

1. Were students involved with the S-LP, and what were their dynamics?
2. Were they more or less motivated than they were with other activities on the course?
3. Have the students learned the technical concepts of the course through the S-LP?
4. Have students developed the personal skills set as a goal throughout the S-LP?
5. What is your general assessment of the S-LP?
6. What personal lessons did you take home from the S-LP experience?

### 3.2. Analysis of the Results

Since all the survey questions were open-ended, the results were sentences. These texts were qualitatively analyzed, dividing them into independent units, and thereby obtaining text fragments; grouping the text fragments by the aspect they dealt with (utility of the project, relation to engineering, critical appraisal, etc.); and conducting a hierarchization in which the groups were ordered according to their importance and the number of text fragments they incorporated. In this way, a global vision was obtained from a series of individual elements [38]. In addition, there was continuous feedback among the authors of the study, so that the aforementioned process and the qualitative analysis previously carried out by the others was successively and progressively performed [6].

The large number of text fragments obtained in the answers to the first question of the student surveys and their complex grouping led to the qualitative results being complemented with a word-cloud mixed analysis to provide the results obtained with a more solid basis. This analysis simply consisted of counting the number of times a word was repeated in all texts and representing it in the form of a word cloud [39] where the frequency of repetition determined the size of the words, so the more frequently repeated words appeared in larger sizes [40].

## 4. Results and Discussion

### 4.1. Student Survey

#### 4.1.1. First Question: Utility of the Proposed Agri-Food Buildings

In their answers to the first question of the survey, the students showed a clear social awareness of the problem of rural depopulation. In addition, some of them also indicated the key role that they could play as agricultural engineers with regard to rural depopulation, as they recognized that they could place their technical knowledge at the service of society to try to solve this problem. It was therefore considered that the results had been achieved, and that the students had acquired the social competencies set out in the S-LP. As indicated in the bibliography, an S-LP is an educational learning experience that is useful to society, either because a problem is directly addressed or because awareness of a problem is raised among people who can engage with it in constructive ways [8,38]. These aspects were achieved in this case, as the future agricultural engineers claimed a role that they thought they could play in addressing the problem of rural depopulation.

*"[...] rural depopulation is a major problem facing all villages [...]"*

*"[...] people migrate to other places where the job offer is greater [...] employment must be generated in rural areas [...]"*

*"[...] implementing projects such as mine or those of my classmates which generate employment can help to ensure that depopulation is not so damaging [...]"*

*"The knowledge we acquire in this and other courses can be of help in the fight against depopulation [...]"*



In addition, a critical attitude surfaced among the students in relation to the different proposals. It was evident in the way that all the students critically valued the utility and effectiveness of the agri-food buildings developed both by themselves and by their classmates to counter the problem of depopulation. The development of critical thinking through S-LP projects, an aspect on which different authors agree, is a seed that can lead to proposals addressing deeply rooted social problems that, as is the case of rural depopulation [34], may not have a direct and immediate answer [10,11].

*"[...] I consider that building animal farms would be appropriate to generate settled populations, because they need personnel for the jobs that they involve [...] these jobs would be indefinite, since the animals need all-year-round care [...]"*

*"[...] the warehouses do not provide so many jobs directly, although having storage facilities available to farmers they may decide to plant in that area [...]"*

*"Both the composting plants and the feed storage facilities [...] are very attractive from the point of view of livestock farms [...]"*

*"[...] building warehouses in which to keep machinery generates no added value for the territory nor to keep a stable population."*

The development of critical thinking was also noted in the identification of problems to be solved in the proposed agri-food buildings and by listing complementary measures. The resolution of a deep-rooted social problem such as rural depopulation not only requires a good proposal, but that proposal also needs favorable conditions for it to be successfully developed [31,41]. It was therefore observed that all the activities developed within the framework of the S-LP led the students to acquire a global vision of the depopulation problem, and to address as many aspects as possible for a successful outcome. A well-developed S-LP with a social approach can raise awareness of social problems and their implications, so that projects can be proposed from a global perspective [17] that may in time be truly successful.

*"[...] poor planning and economic management of these projects can make them unsuccessful [...] therefore these two aspects must be borne in mind [...]"*

*"[...] the people involved in the starting agri-food industry need motivation and advice to start a successful project, which is always complicated [...]"*

*"[...] it must be noted that even if the proposed buildings are located in a rural municipality, it is necessary to encourage the people who work there to stay and live in that municipality, as there may be some who do not and live in other municipalities further away."*

*"[...] good management of the waste generated is necessary, fundamentally on farms [...] respect for the environment is fundamental in rural areas and without it no proposal will be valid [...]"*

Figure 5 shows the word cloud with the 10 words that the students repeated most when answering the first survey question and after removing the stop words (i.e., prepositions, determinants, etc.). As may be expected, words such as "depopulation", "rural", "farms", "storage", and "jobs" appeared in the word cloud, words that were directly linked to the problem of rural depopulation addressed in the S-LP. However, other words were also found that illustrated the aspects discussed above. First, the word "aware" showed student awareness of the social problem that was addressed. Second, the terms "technical", "role", and "engineer" revealed that the students could through the S-LP see the role they might play in solving this problem, based on their education as agricultural engineers. Finally, the term "overall" was indicative of the need to address this social problem bearing in mind all its facets, so that both effective and successful proposals might be implemented.



**Figure 5.** Word cloud for the first question of the student survey.

#### 4.1.2. Second Question: Other Possible Measures to Solve Rural Depopulation

The second question posed to the students was aimed at encouraging them to devise possible approaches to the problem of rural depopulation other than the construction of agri-food buildings. The purpose behind this question was to assess the degree of understanding and awareness of this problem that formed part of the S-LP, thus complementing the previous question, to evaluate the success of this teaching experience from the social viewpoint.

The first aspect to highlight is that many students continued to refer to the utility of designing agri-food buildings. It showed that the students considered it a useful approach to mitigate rural depopulation, even after the knowledge of this problem attained by the students during the S-LP. The social approach that can be adopted for some technical engineering courses is therefore clear, to awaken a sense of social service in future engineers [25,42].

*“[...] livestock farming is the sector with the most notable potential to fix rural population [...] livestock farmers are forced to live in the rural environment to run their businesses [...]”*

*“The best step forward would be to create farms or warehouses where there would be enough jobs [...]”*

*“[...] the option of building food processing/transformation factories that generate jobs in the villages can also be chosen, since no project related to this approach has been proposed [...]”*

However, the proposals of the students were not limited to agri-food buildings and addressed a wide range of other areas. Among them, ideas based on their future role as agricultural engineers could be found. This revealed an aspect already noted in the answers to the first question, which was the fact that the students established a clear link between their technical formation as agricultural engineers and the part they can play in solving social problems within their professional field. From a generic approach, the work of an engineer is to perform a social service [43], trying to respond to the needs of the population [44]. S-LP teaching experiences are a good way to awaken this vocation in engineers from the time of their training, so that it can be kept in mind throughout their whole professional life [27,30].

*“[...] there are fewer and fewer people who want to dedicate themselves to the agricultural sector, so promoting and developing social activities derived from or involving the agricultural sector by an agricultural engineer [...] I perceive it as a useful response.”*

*“[...] the creation of industrial parks with companies within the agro-livestock sector where people can stay and work and so that rural workers do not have to go to the big cities to buy phytosanitary products and fertilizers [...]”*

*“[...] there are mountains that are full of weeds and extensive livestock farming is disappearing, which were responsible for clearing the mountains, so we could consider projects to clear up the mountains and improve rural roads, attract new population, generate jobs and improve the conditions of the rural environment [...]”*

Finally, projects related to financing and housing for people in rural areas were also proposed. As found in the answers to the first question, a global understanding of the problem of rural depopulation on the part of the students was noted. They were aware of the different aspects that needed to be considered, in order to address this problem; a fundamental aspect to be able to propose complete responses that cover all aspects and that can be really successful [23].

*“[...] the receipt of certain subsidies, such as those linked to the common agricultural policy, could be made conditional on living in the rural environment [...]”*

*“[...] to provide affordable housing for workers in the rural world [...] it would be beneficial for the municipality to have small pieces of land to plant or to raise vegetable gardens and animals, to encourage activity in the rural world [...]”*

*“[...] to implement new technologies, which many of the villages do not have such as Internet access, would be very helpful because farmers must present or share tables and reports with the amount of grain harvested for example.”*

*“Villages that are close to each other could coordinate the development of agricultural days, talks with experts in the field, increase the number of school trips to the countryside [...]”*

*“If there is a small or medium enterprise in a village, try to keep it in the village and hold sales days or market its products [...]”*

#### 4.2. Survey of Teachers

The survey administered to the teachers involved in the S-LP was intended to find out whether they thought the students had learned the concepts of the course, set as academic and personal competencies in the definition of the S-LP. In the end, the teachers were the ones who graded the projects and attended their presentations, so they had a clearer vision of this aspect [12]. In addition, their personal assessment of the S-LP was also requested and their own learning and implication, as an S-LP should ensure that all the actors become aware of the problem that is addressed [16,17].

##### 4.2.1. Evaluation of Students

The first question for the teachers was whether the students had been involved in the S-LP and whether they had shown interest and an active attitude towards it. The need to know these aspects was due to the fact that for a novel teaching experience to be successful, the first thing that must be awakened is the interest of the students. They are expected to learn not only from the aspects developed in class or the compulsory subjects forming part of the teaching experience [3], but also through self-learning by themselves [22]. The teachers' assessment of this aspect was positive, highlighting the independence and good communication of the students during the S-LP and their greater involvement as the S-LP progressed.

*“[...] the students have worked very well [...] also in the parts that required independence and collaboration with other classmates [...]”*

*“At all times there has been very good communication, both student-teacher and student-student [...]”*

*“From the very beginning, the students showed interest in the subject of S-LP, and they were more and more involved as they progressively explored the topic [...]”*

While the first question of the survey for the teachers sought to determine whether the students had been motivated, the second question asked about their degree of motivation. To that end, the teachers were asked to measure student motivation in comparison

with other activities performed on the course. A motivation level is a complex aspect to define [45,46], so it was thought that a good way of measuring it might be to take habitual practice on the course as a reference. Greater motivation is an indicator of a greater willingness and an active attitude towards learning the concepts of the course [47], possibly thanks to the greater interest aroused in the students [48]. In relation to this aspect, the teachers indicated that their perception of the motivation raised by the S-LP in the students could be equated to that of the workshop-practice part of the course, which was generally the part of the course in which the students showed the greatest interest. Thus, the teachers thought that the S-LP was a beneficial way for the students to approach the design aspects of agri-food buildings addressed in the course and considered it of clear utility.

*“The motivation for this activity has been high [...] it is an exercise that is very close to their professional activity in the near future and addresses a subject with an important social awareness [...].”*

*“[...] this course has workshop practices, which is the aspect in which the students are usually the most interested [...] the students showed a similar interest in the S-LP and in these practices [...] I think that both teachers are very satisfied with our involvement in the S-LP proposal [...].”*

The third and fourth questions asked the teachers whether the students had acquired the academic and personal competencies established in the S-LP. The acquisition of social competencies was assessed through the student survey. In the current teaching framework, student learning is based on the acquisition of competencies [49]. Their correct acquisition is an indication that the objectives of the course have been achieved [50]. It is therefore essential to assess the acquisition of the course competencies in a novel teaching experience, as the fundamental basis for this type of teaching activity must be that the students learn the necessary professional concepts [4]. The teachers gave positive responses to both types of competencies, indicating that each one had been properly acquired. The theoretical and practical concepts explained in class had been successfully applied during the projects, while in relation to personal competencies, the students had acquired the capacity for independent work and were able to search for and to digest the necessary information for successful development of the project. However, the teachers also indicated that some students showed weaknesses relating to that aspect, suggesting as a possible point of improvement for future S-LP experiences that teachers should guide students more closely in the first steps of an information search, instead of looking for highly independent work from the start.

*“The projects that were developed were technically sound [...] the design concepts explained in class were correctly applied [...].”*

*“[...] although there are small aspects that could be improved, as in any work done by students because in the end they are still learning, all the agri-food buildings that were developed could be implemented [...] they also had proper calculation reports and adequate plans [...].”*

*“[...] the students worked in many phases of the S-LP autonomously [...] possibly because they were addressing a problem close to them through the projects [...] on other occasions I detected that it was necessary to guide them more during the project [...].”*

*“In general, the students started out with adequate information that they themselves sought [...] however, more initial support in the search for information would have been beneficial in some cases [...] this would perhaps have helped to reduce the notable differences of level among the students between the geographical framing and the justification of the needs of the geographical area addressed in the project [...].”*

#### 4.2.2. Personal Opinion

In relation to the question referring to the overall assessment, the teachers stated that they were very satisfied. Their reflection focused on the idea that most engineers would play an active role in the improvement of their surrounding area, if they could, and agricultural engineers might therefore consider playing active roles to improve the rural

environment in which they work, an aspect that could be instilled in the students through S-LP experiences and which is the final objective of this type of teaching experience in engineering [24,29]. The teachers also highlighted the social awareness achieved through the S-LP.

*“[...] I think that in general we are very satisfied with the overall development of the experience [...]”*

*“We engineers are an active part of the process of improving the environment [...] and the needs of the rural environment must be addressed by agricultural engineers through economically and technically viable answers [...]”*

*“[...] this opportunity has brought the students closer to the reality of their professional field, raising their social awareness [...]”*

The last question that the teachers were asked addressed their own learning throughout the S-LP. The teachers recognized that they had learnt during the S-LP, as an S-LP experience generally raises awareness of a social problem that the participants have to address [14]. However, the teachers also emphasized that they had learnt three aspects through S-LP. First, it had helped them to consider new similar initiatives that they could apply to their courses, so as to encourage more active learning among the students [6]. Secondly, it had helped them to identify other social needs that an agricultural engineer can consider addressing and that addressing them in class can make the concepts explained more useful. Finally, it also enabled them to become aware of the role that the university can play in engaging with some societal problems. The university has professionals who are capable of solving these problems and has the necessary means to raise awareness of an issue and how to engage it [9,11].

*“[...] I think it is clear that not only the students, but we have also become aware of the problem of rural depopulation [...]”*

*“The reflective exercise that we have conducted [...] has helped us as teachers to consider new initiatives of this type [...] and we have also identified other social aspects in which we as technicians, both students and teachers, should become involved [...]”*

*“[...] the university is a very important entity to make known the great challenges of society [...] and that can be used to propose good approaches that could help to alleviate some current and future social needs”*

## 5. Conclusions

A Service-Learning Project (S-LP) was implemented on the Construction & Agroalimentary Building course of the third year of the Bachelor’s Degree in Agroalimentary Engineering & the Rural Environment at the University of Burgos, Spain. The objective was to address the social problem of rural depopulation through the design of agri-food buildings for new industries and economic activities that could generate employment and workplaces and, thereby, a more stable population. This topic was chosen for the S-LP because it is a very pressing problem in the rural area of Spain, and for which agricultural engineers can play a key role in its solution, since it directly affects their field of action. After the completion of the S-LP, students were surveyed to elicit their opinions on this teaching experience in terms of the social-service approach, always bearing in mind that the S-LP had a hypothetical approach, without implementing and testing the effectiveness of the proposed agri-food buildings. The following conclusions can be drawn from the analysis of their responses:

- The S-LP raised awareness of the social problem of rural depopulation and the proposals to address it, not only among students but also among teachers. It has therefore been confirmed that an S-LP is a teaching experience that, if properly conducted, can awaken a social commitment in all those involved.
- Participation in the S-LP fostered a critical spirit among the students, so that they not only looked for answers to the problem, but also sought the best way to solve it. In addition, all the activities performed led the students to reach a global vision of the social need. It meant that when proposing ways to address the issue of rural

depopulation, they considered all its aspects and implications, so that the problem could be successfully addressed.

- Reflection on the social problem and the search for answers based on technical knowledge also helped the students to conceptualize a sense of social service as part of their profession as engineers. In this way, they realized that, as engineers, they could apply their technical knowledge to address existing social needs.

In addition to raising students' awareness and critical thinking about a social problem, an S-LP should also facilitate learning of the course content. Teachers were surveyed, to evaluate the level of learning of the students throughout the S-LP, and the following conclusions were drawn regarding this aspect:

- The S-LP aroused student interest and motivation to learn the concepts addressed during the course. Motivation levels were similar to those found in the workshop practices, the part of the course preferred by the students, perhaps because of the usefulness of the concepts that were directly applied to a social issue.
- The students acquired the academic and personal competencies proposed as the objective of the S-LP from the teachers' viewpoint. They therefore learned the technical concepts explained on the course and developed the capacity for autonomous work and searching for information, although in relation to this last aspect, it is important for the teacher to act as a guide in the first steps.
- Finally, the teachers themselves recognized that they had also learned throughout the S-LP, using this experience as a basis to propose new classroom dynamics and activities to favor active and socially committed learning. To that end, they recognized that it was necessary to rely on the university as a social entity that can make existing social problems visible and that can propose ways of engaging with these issues.

In this study, the advantages and the utility of conducting S-LP experiences, in this case in the field of agricultural engineering, have largely been demonstrated. However, it is also true that this is a teaching experience performed with only a few students on a particular course, which may have favored a greater awareness among them of the social problem of rural depopulation due to the ease with which all of them could actively participate in the S-LP activities. Thus, this limitation of the study could be addressed in the next steps of the research by considering S-LP experiences with larger numbers of students following other courses. In addition, S-LP experiences that simultaneously involve several courses could also be useful, thus overcoming the perception among students of the lack of a linkage between the concepts addressed on different courses.

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